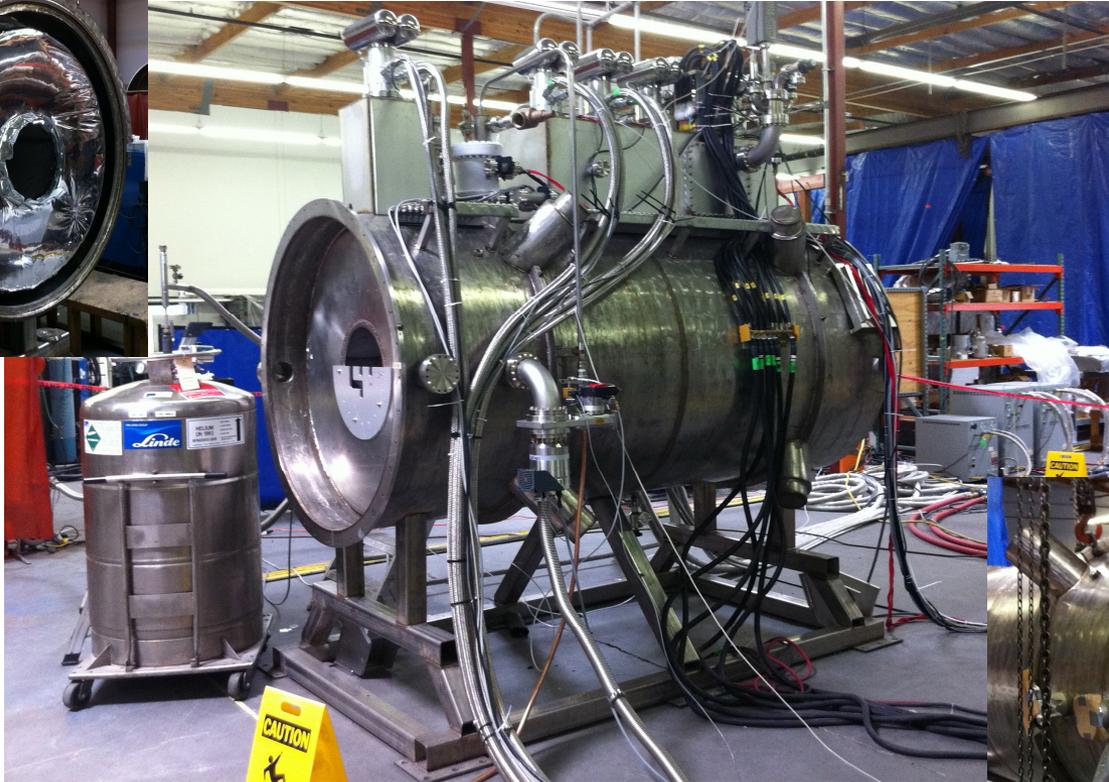




MICE Spectrometer Solenoid Design and Assembly



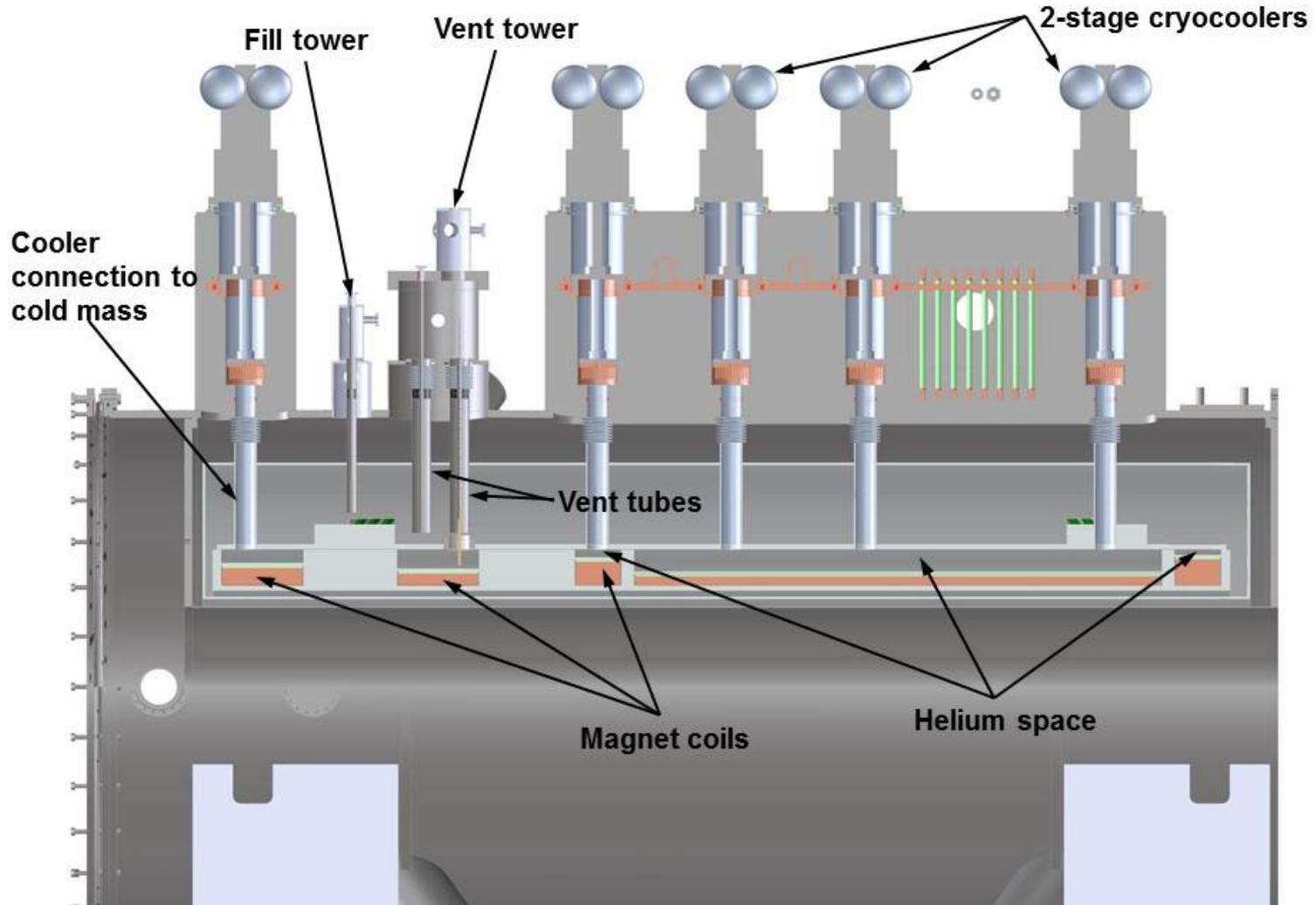


Magnet Design Features

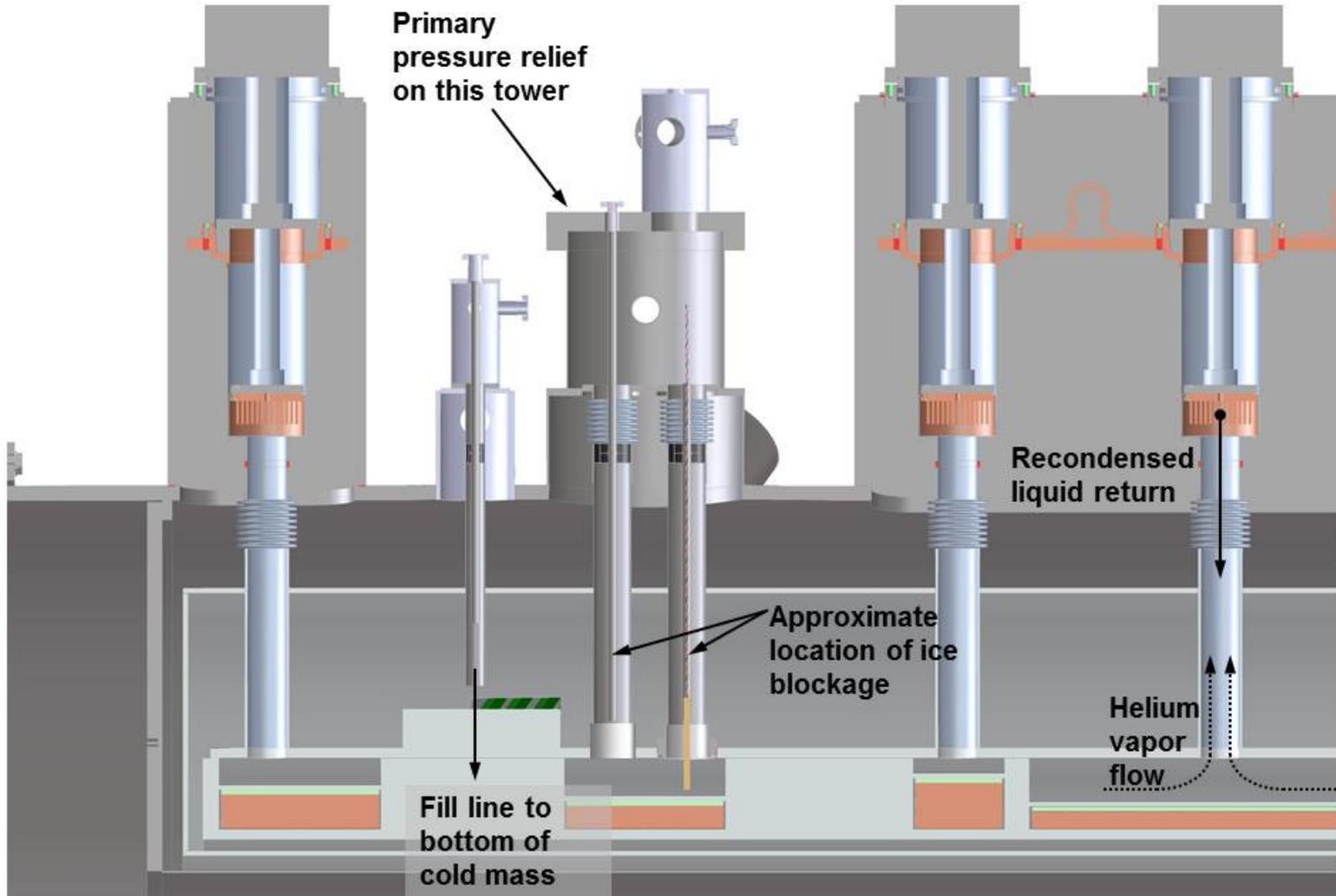


- 5 coils on a single mandrel
- 200L LHe volume in cold mass
- 5 ea 2-stage cryocoolers for recondensing helium vapor and cooling the shield
- Vapor and return LHe pass thru the same cooler tubes at the top of the cold mass
- 8 ea HTS leads feed the 5 coils
- 60K thermal shield made from series 1100 Al

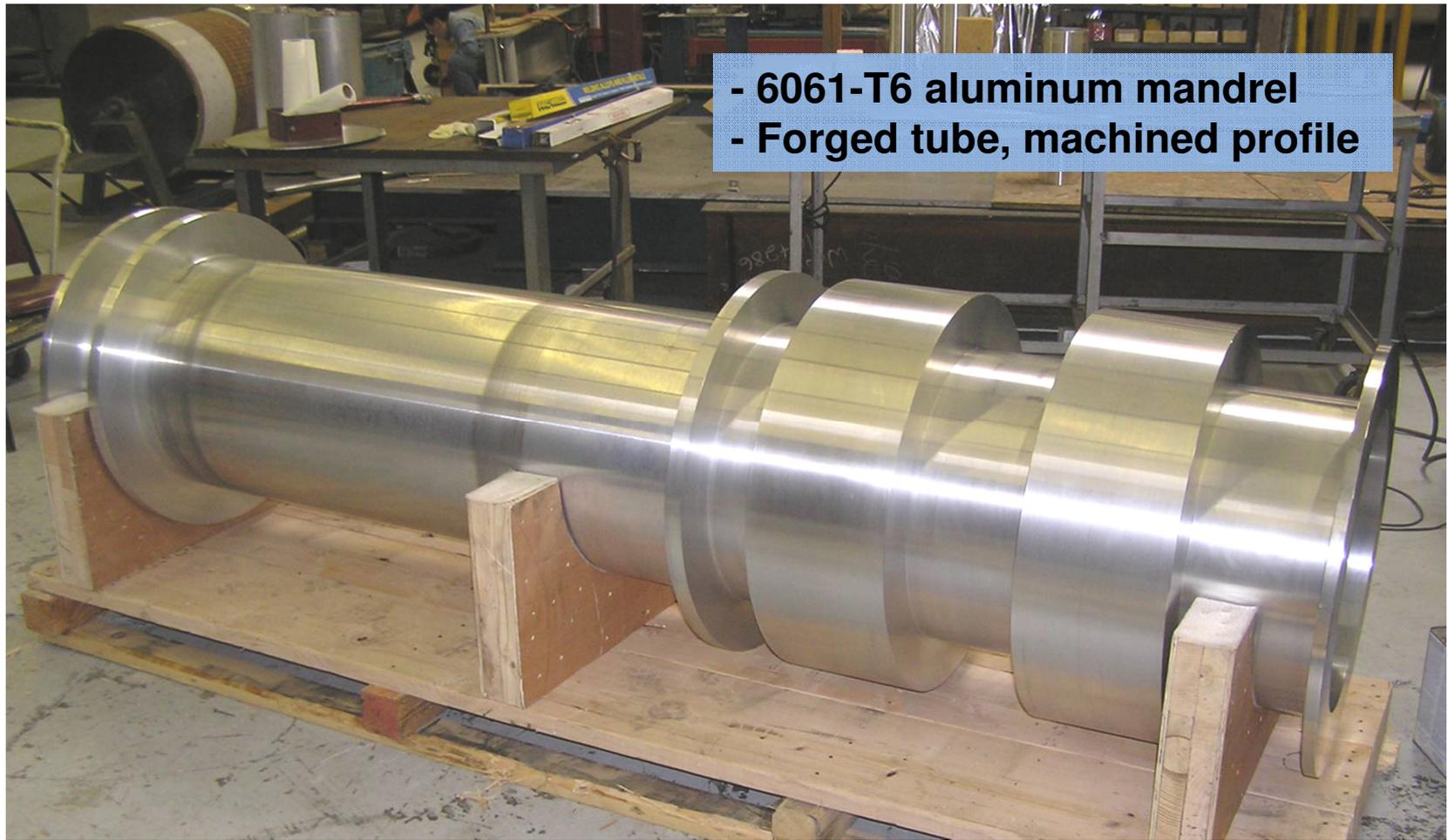
Internal Design Details



Internal Design Details



Coil Winding Mandrel

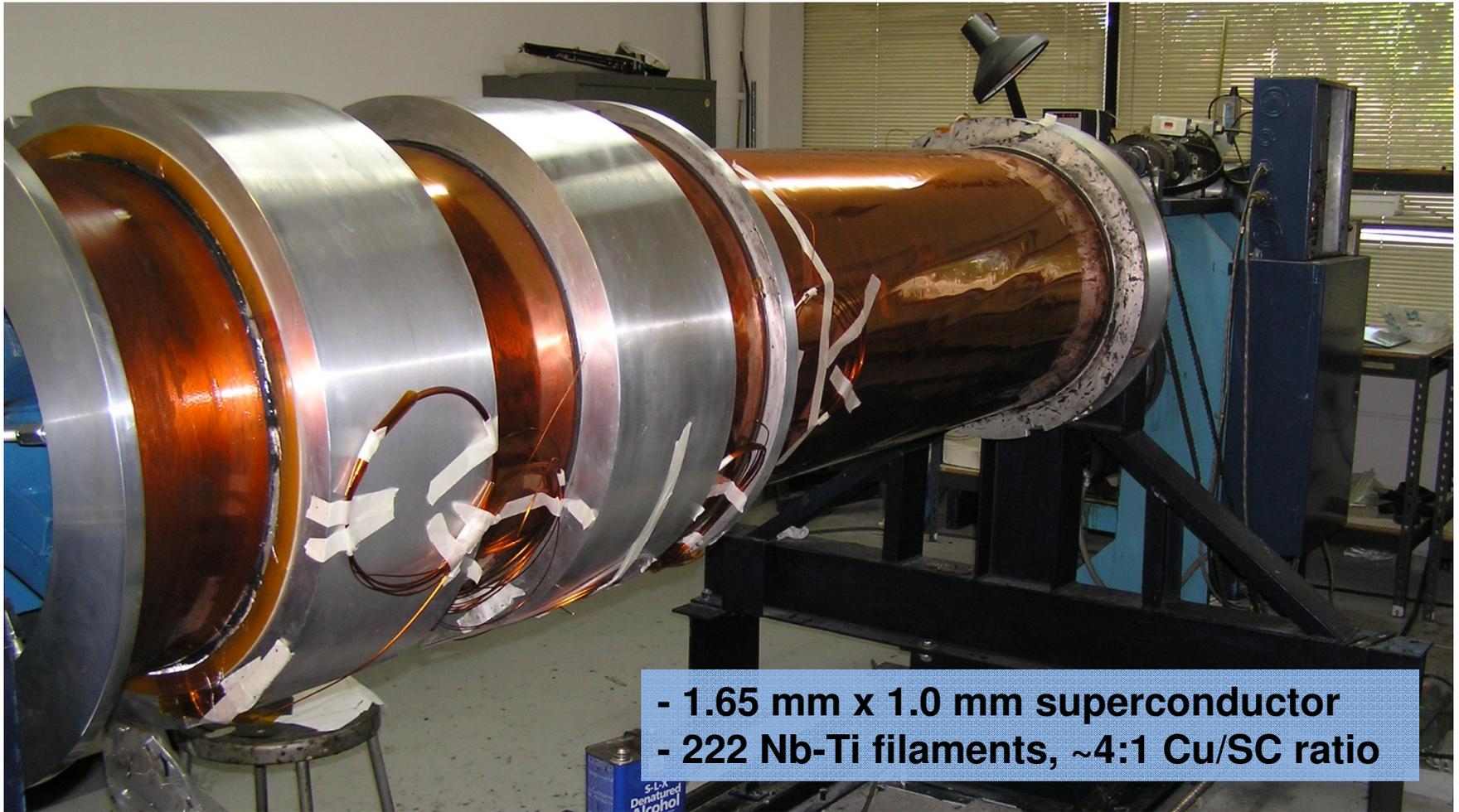




Coil Winding

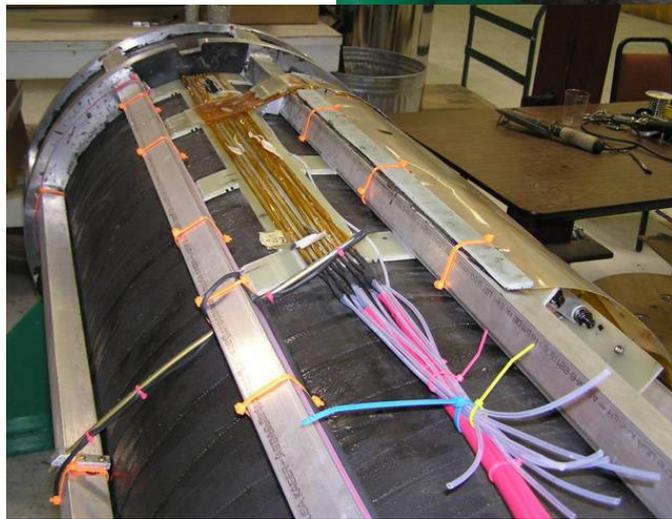


Completed Coil Windings





Banding and Axial Reinforcement



- Wound aluminum banding w/Stycast
- Welded aluminum axial stiffeners



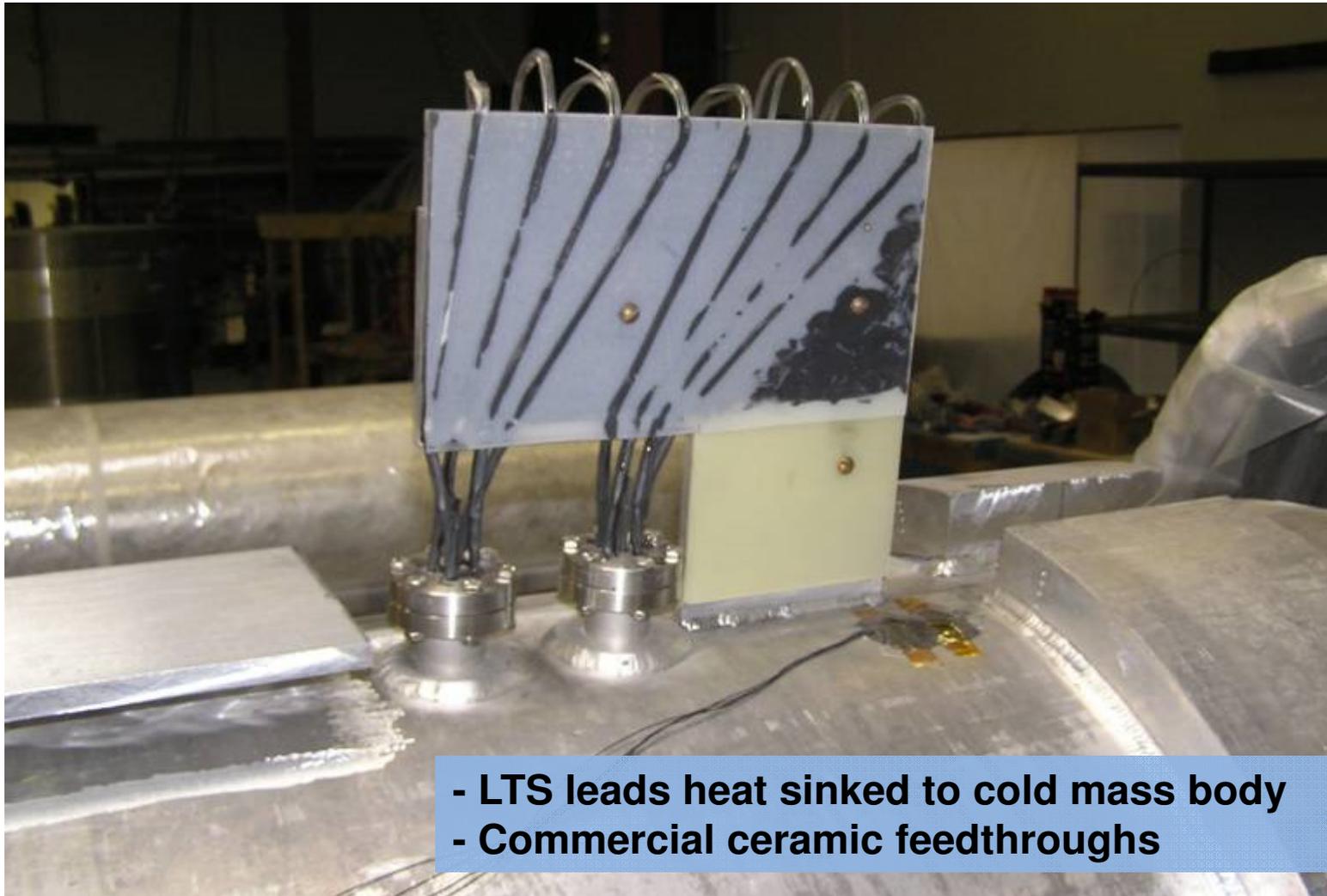
Completed Cold Mass



- Welded aluminum clamshell type cover
- ~200 liter cold mass interior volume



Vacuum Side Coil Leads



- LTS leads heat sunk to cold mass body
- Commercial ceramic feedthroughs



Cold Mass MLI Spacers & Heaters



- Spacers help prevent thermal shorts
- Heaters provide pressure regulation

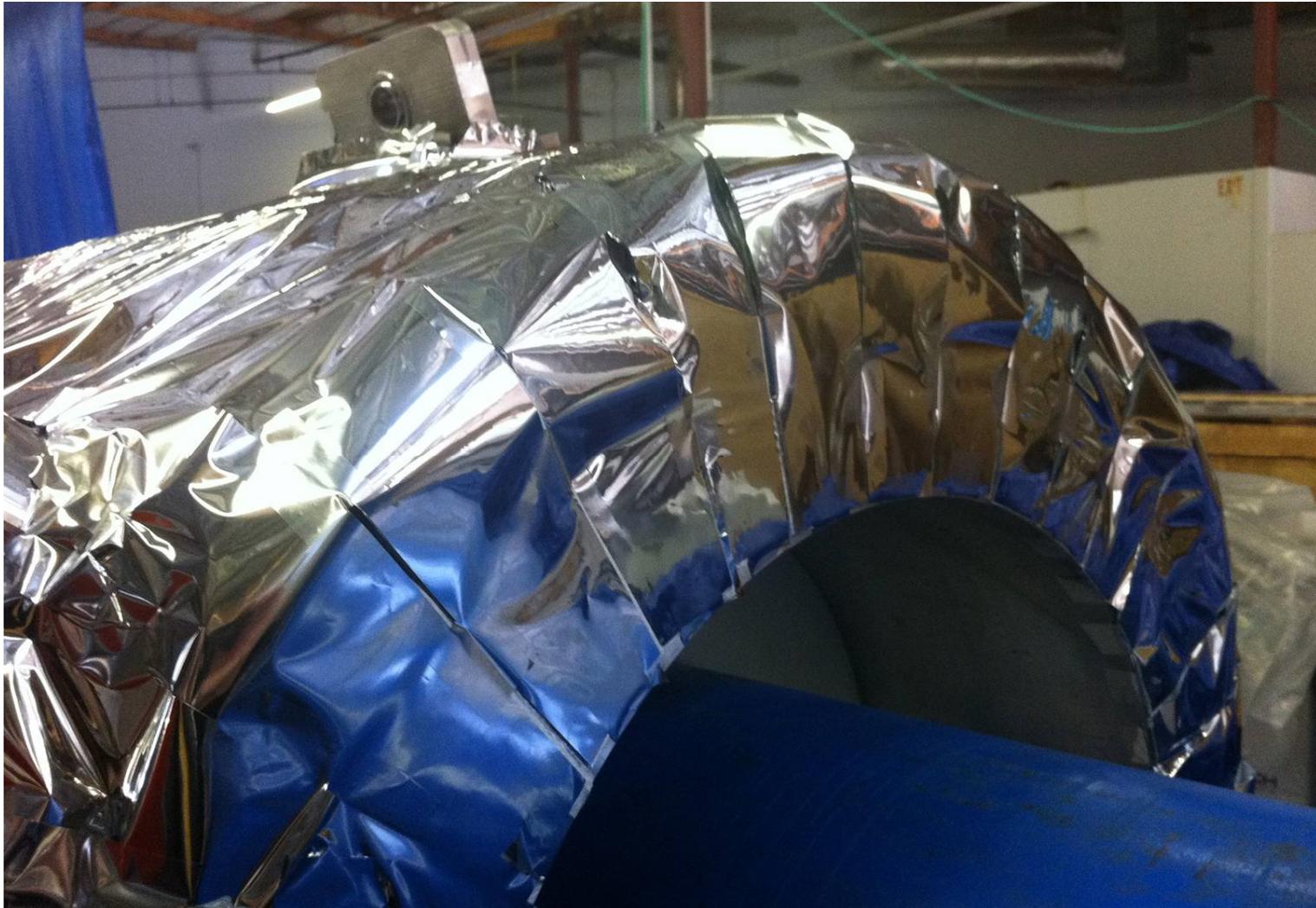
MLI Wrapped Cold Mass



- ~32 layers of aluminized Mylar MLI
- Interleaved joints, Mylar tape



Cold Mass End Wrap Detail





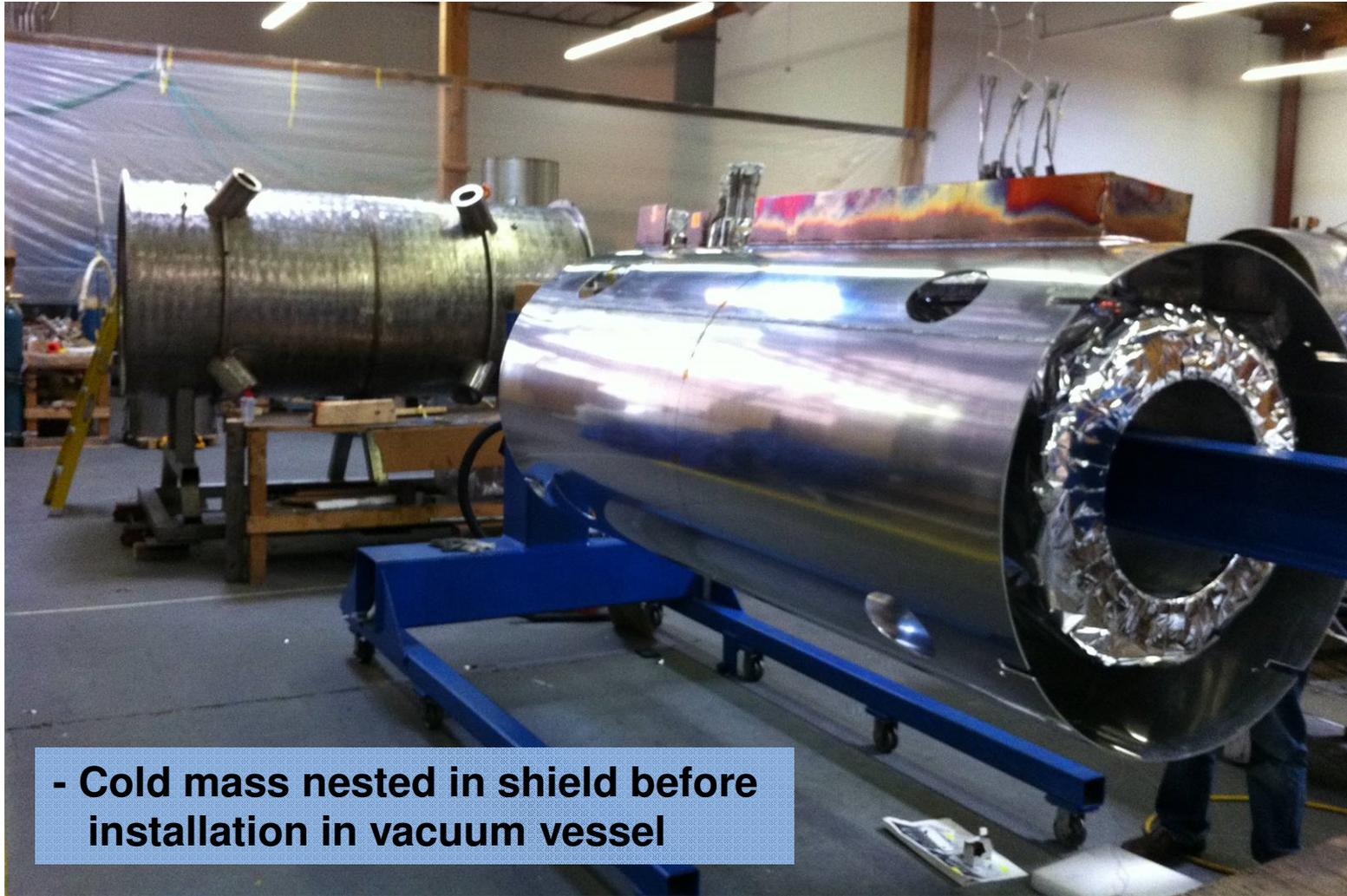
60K Shield Assembly



- Series 1100 aluminum thermal shield
- Copper transition for cooler connection



Nested Cold Mass/Shield



- Cold mass nested in shield before installation in vacuum vessel



Cold Mass Vent and Fill Lines



- Fill and vent lines intercepted at shield
- Thinned out walls limit conduction



Shield Prep for MLI



- ~64 layers MLI on thermal shield
- Fiberglass cloth protects during welding



Shield/Cold Mass Installation





Cold Mass Alignment



- Cold mass alignment using portable CMM

Cold Mass Support Bands

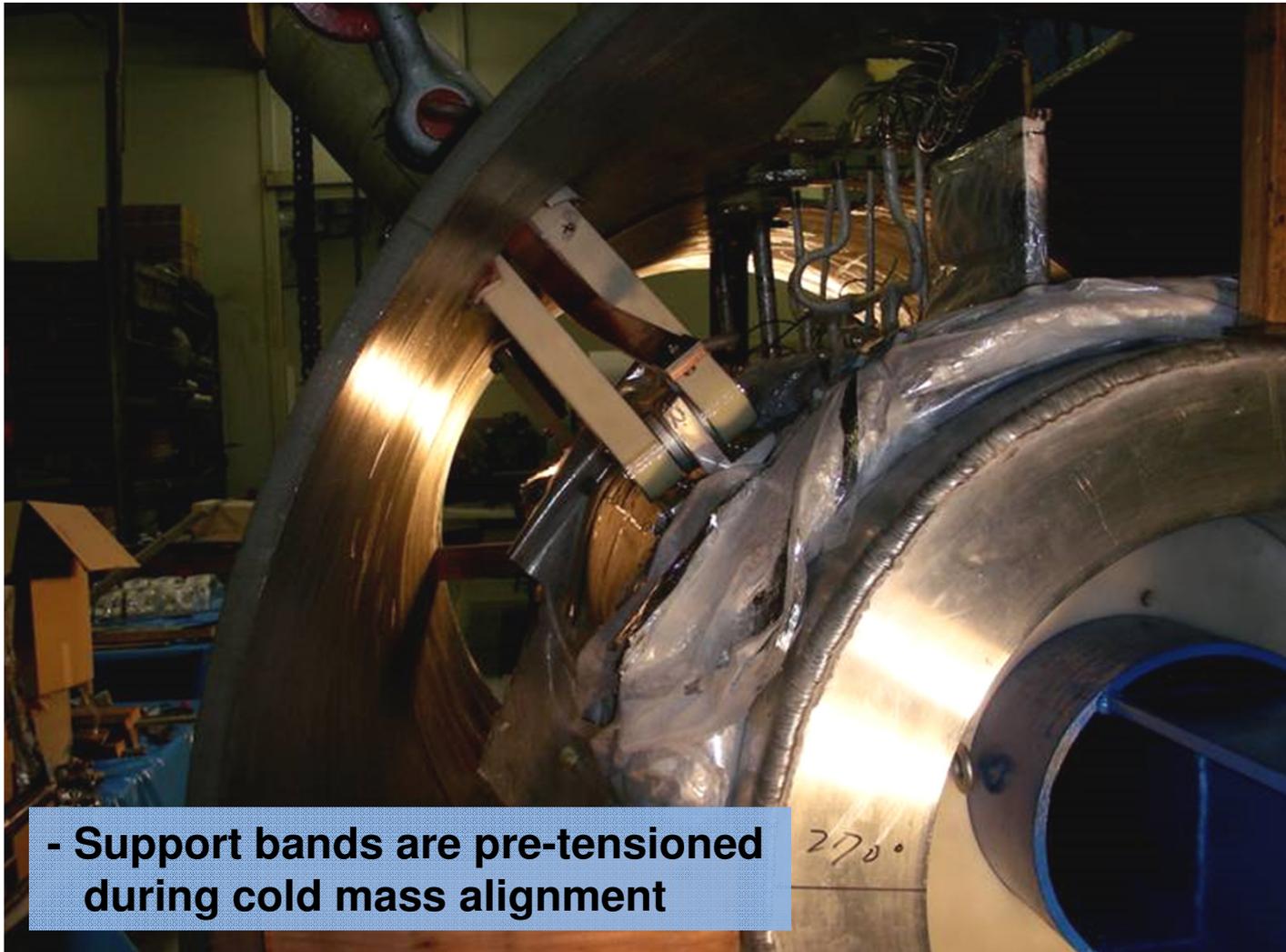


- Fiberglass bands for low heat leak
- Intermediate intercept at 60K shield





Mounting of Cold Mass Supports



- Support bands are pre-tensioned during cold mass alignment

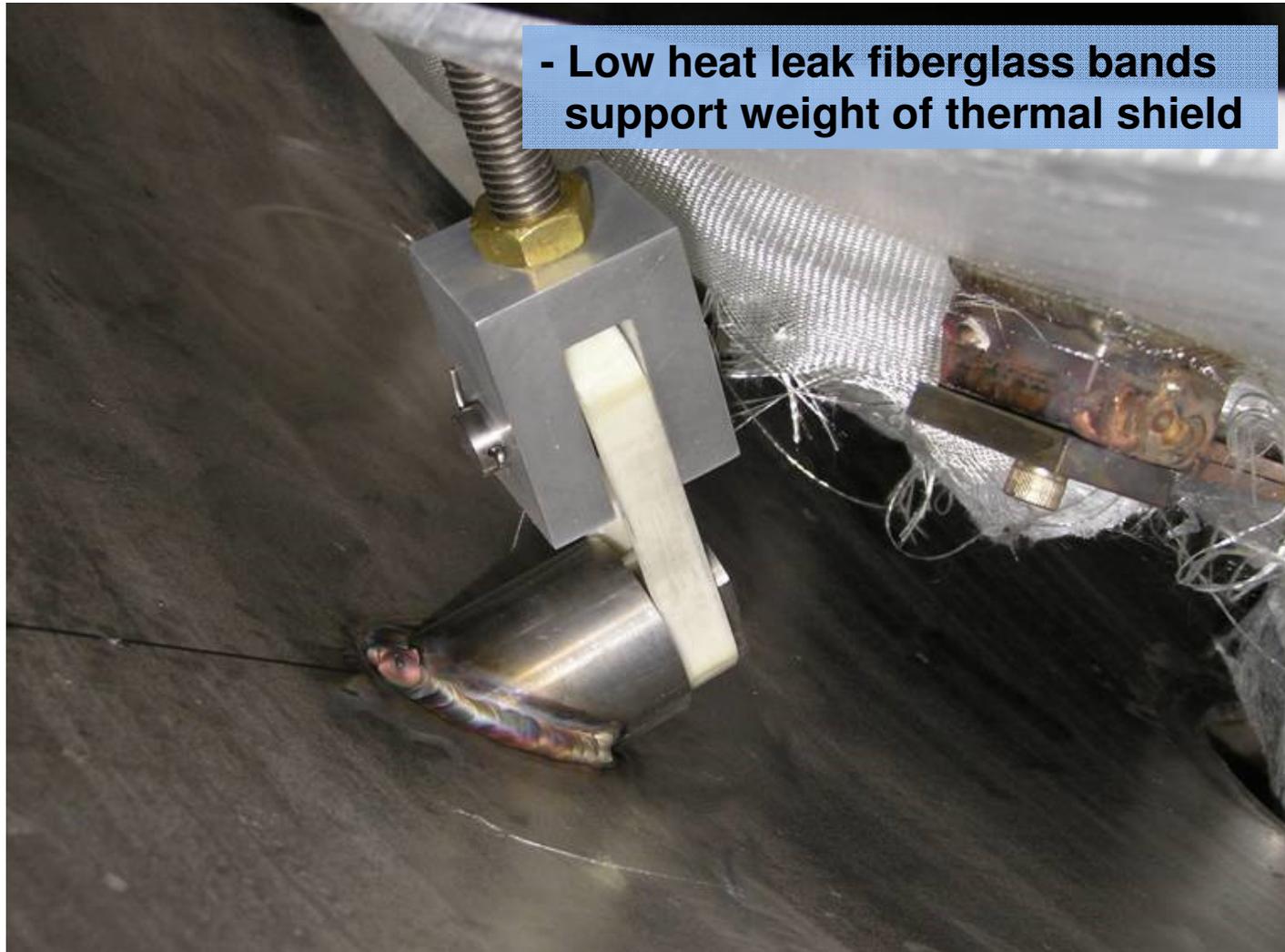


60K Support Band Intercepts





Thermal Shield Support Band



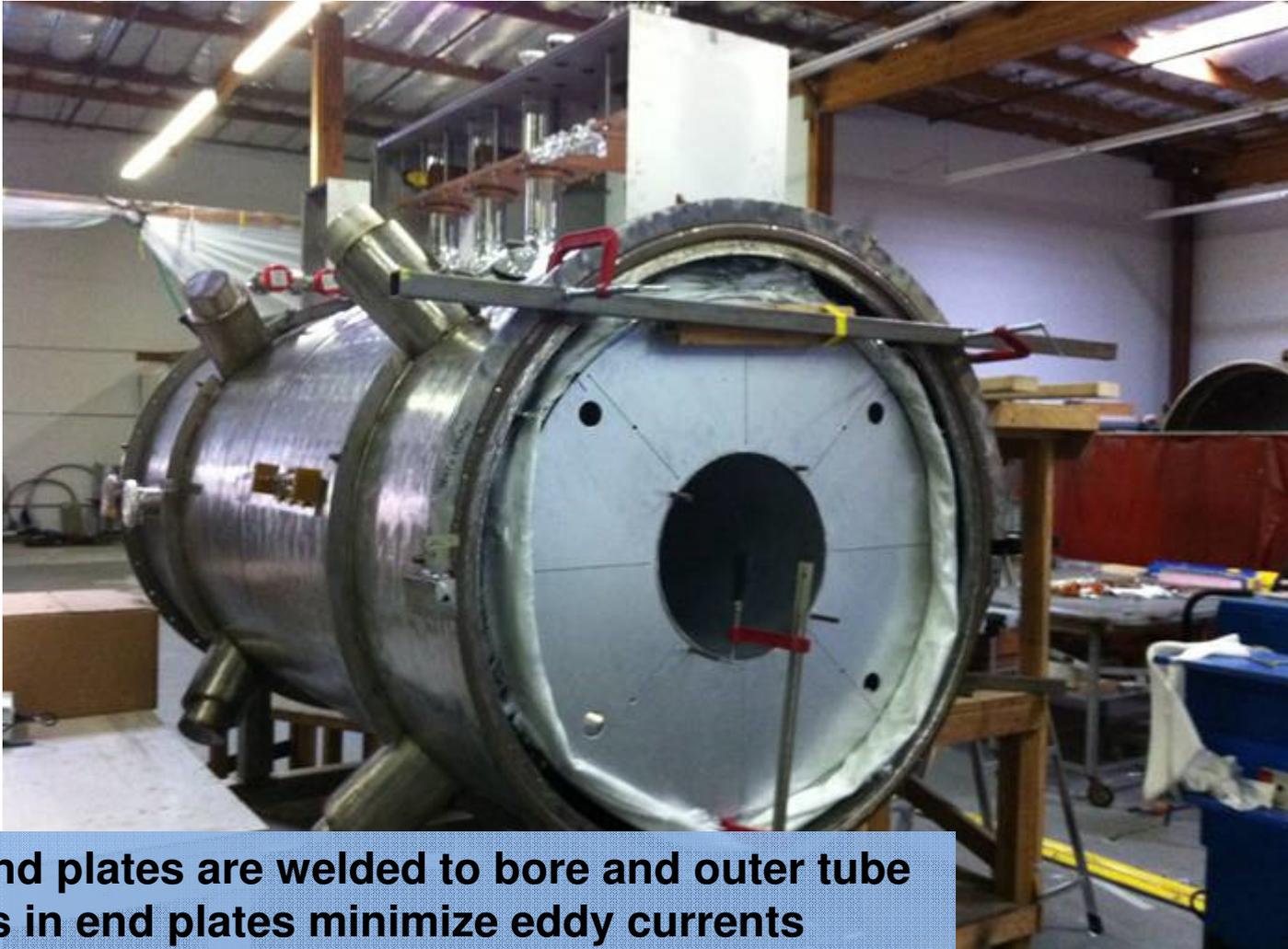


Thermal Shield Bore MLI Wrap





Shield End Plate Installation

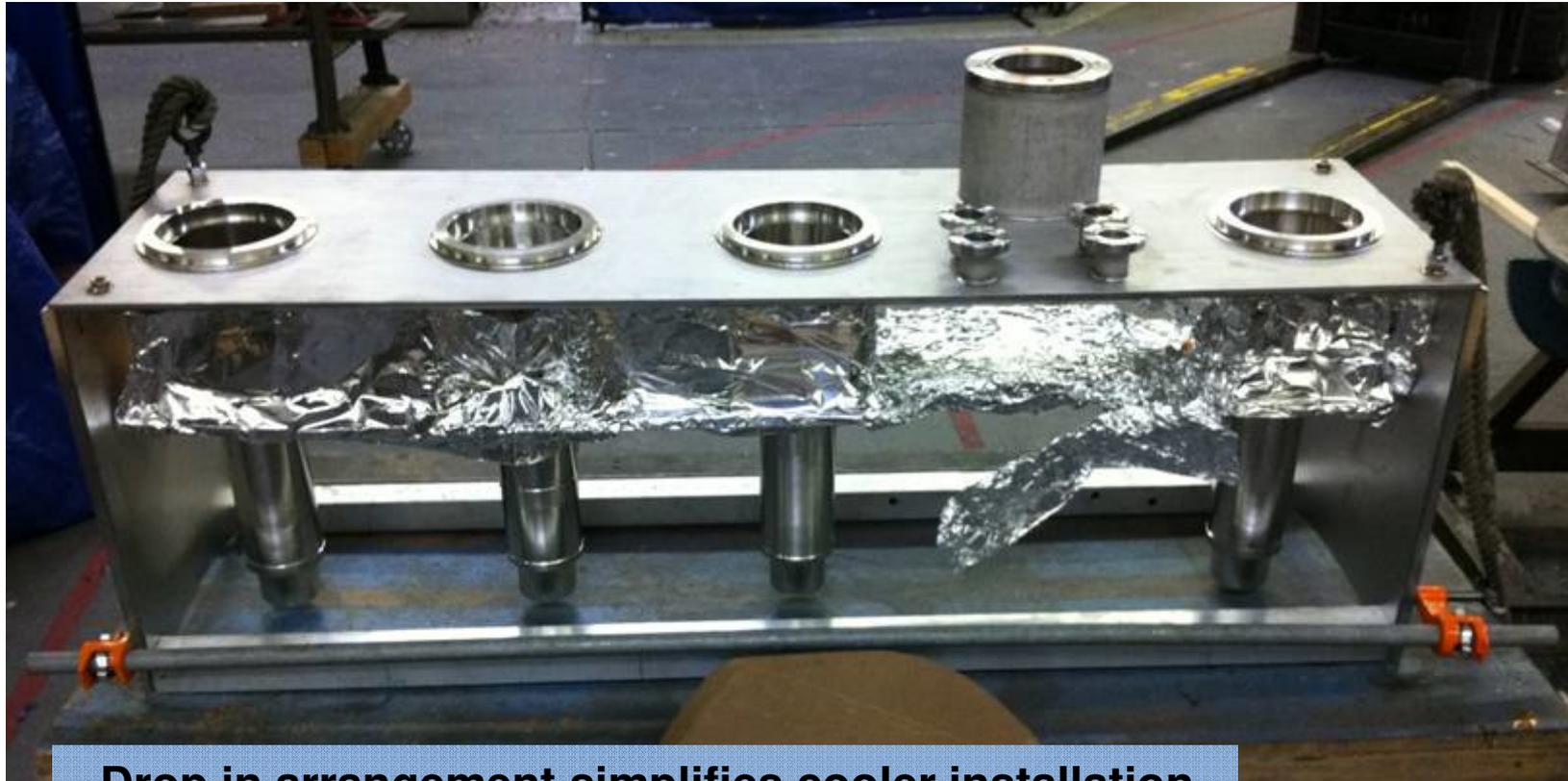


- Shield end plates are welded to bore and outer tube
- Saw cuts in end plates minimize eddy currents



Vacuum Vessel End Wall/Warm Bore





- Drop in arrangement simplifies cooler installation
- Some heat leak in thin walled sleeves

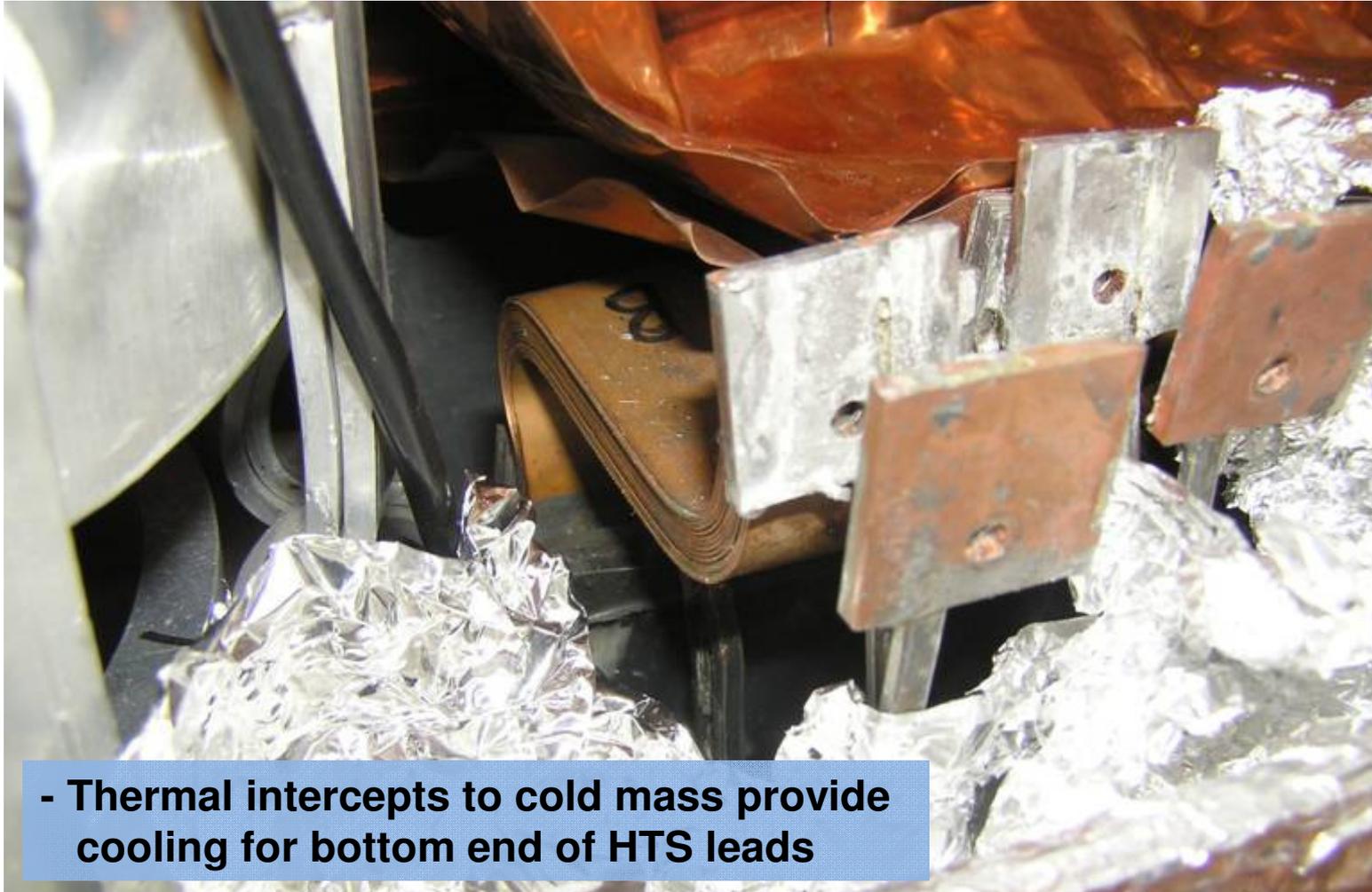


Cooler Tower Install on Vessel





Thermal Intercepts for Lower HTS Leads



- Thermal intercepts to cold mass provide cooling for bottom end of HTS leads



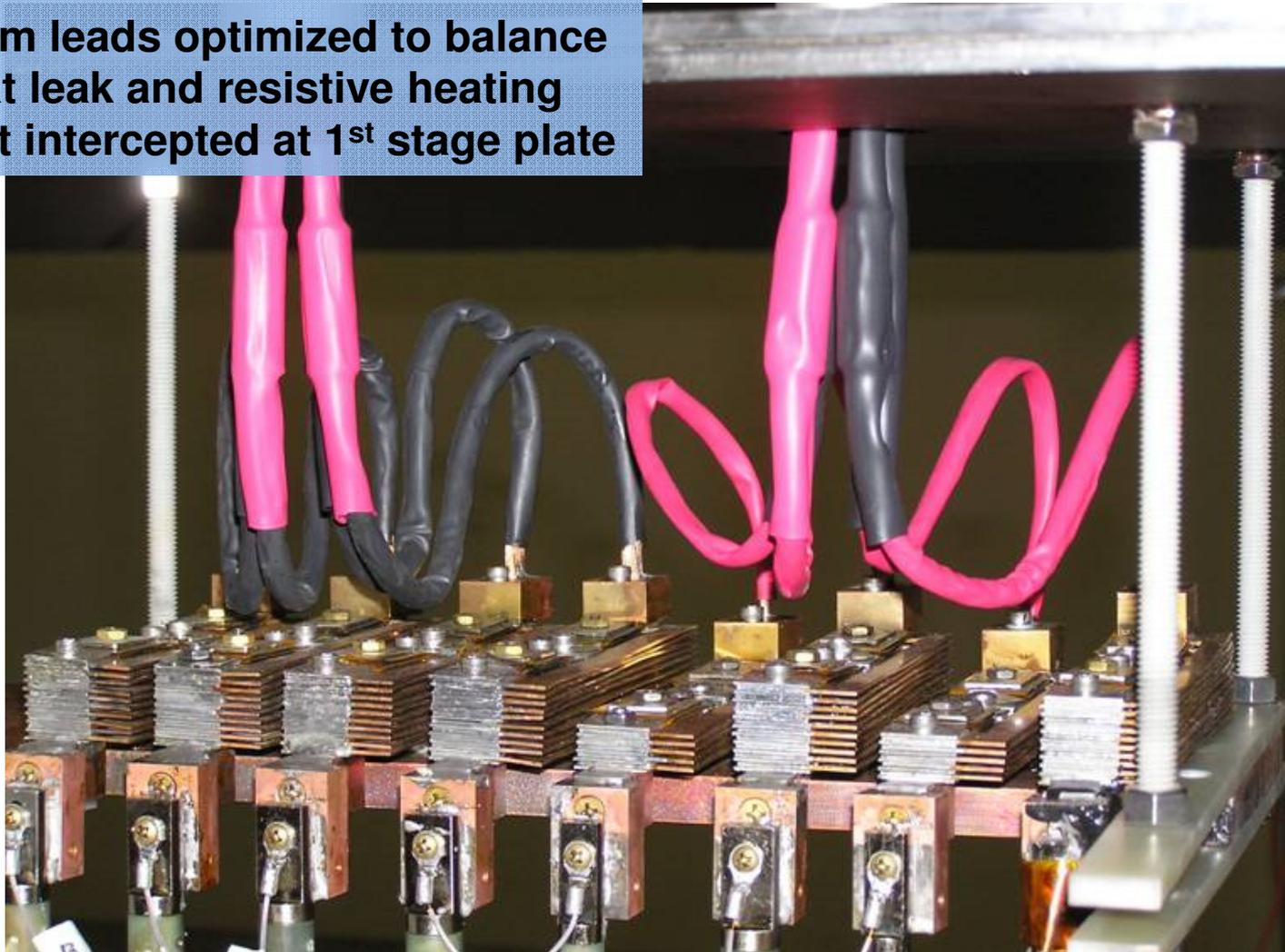
HTS Lead Installation



- HTS leads bolted and soldered at both ends
- Pre-installation tests ensure integrity

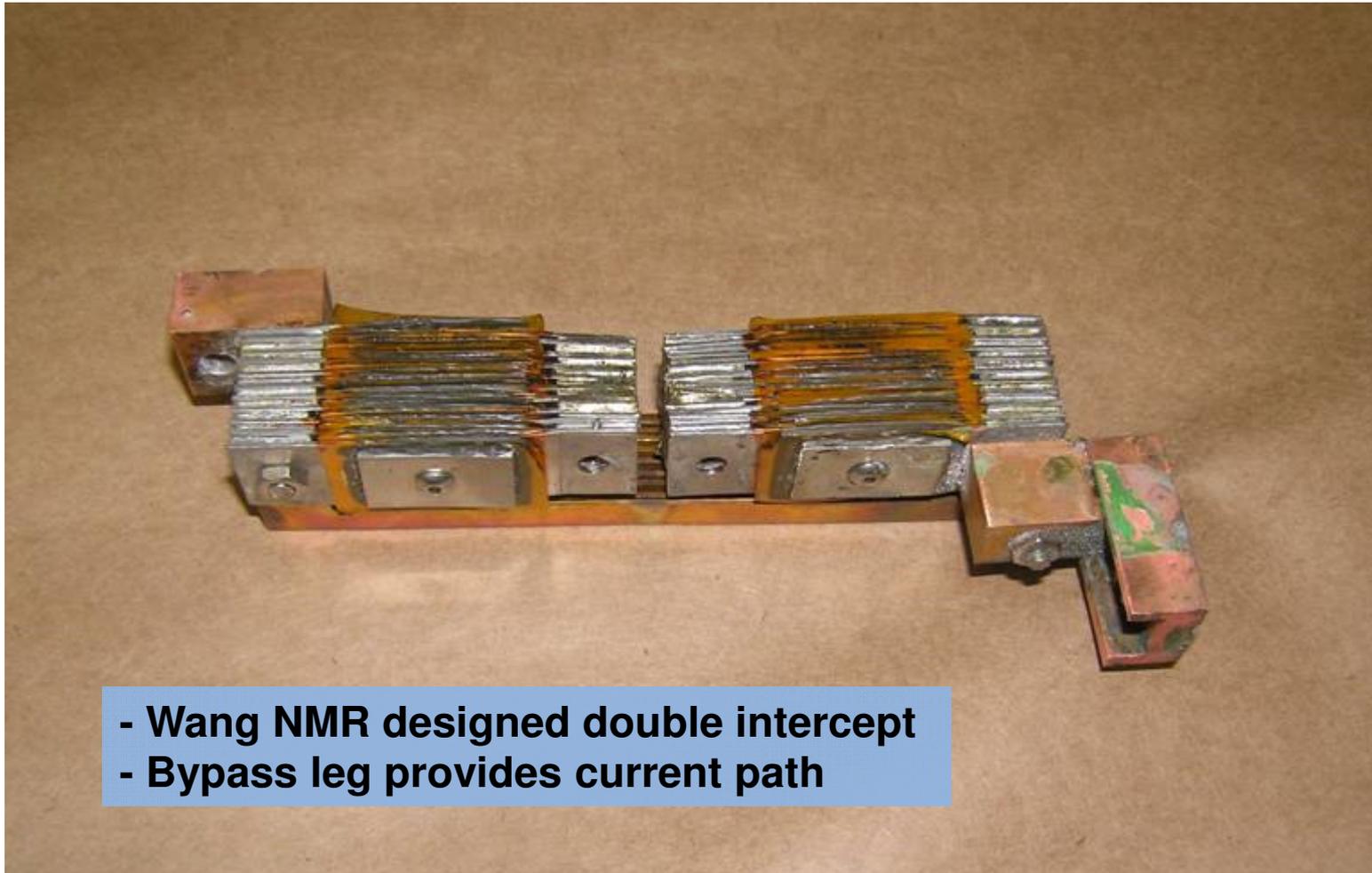
Warm Lead Configuration

- Warm leads optimized to balance heat leak and resistive heating
- Heat intercepted at 1st stage plate





Upper HTS Lead Thermal Intercept



- Wang NMR designed double intercept
- Bypass leg provides current path

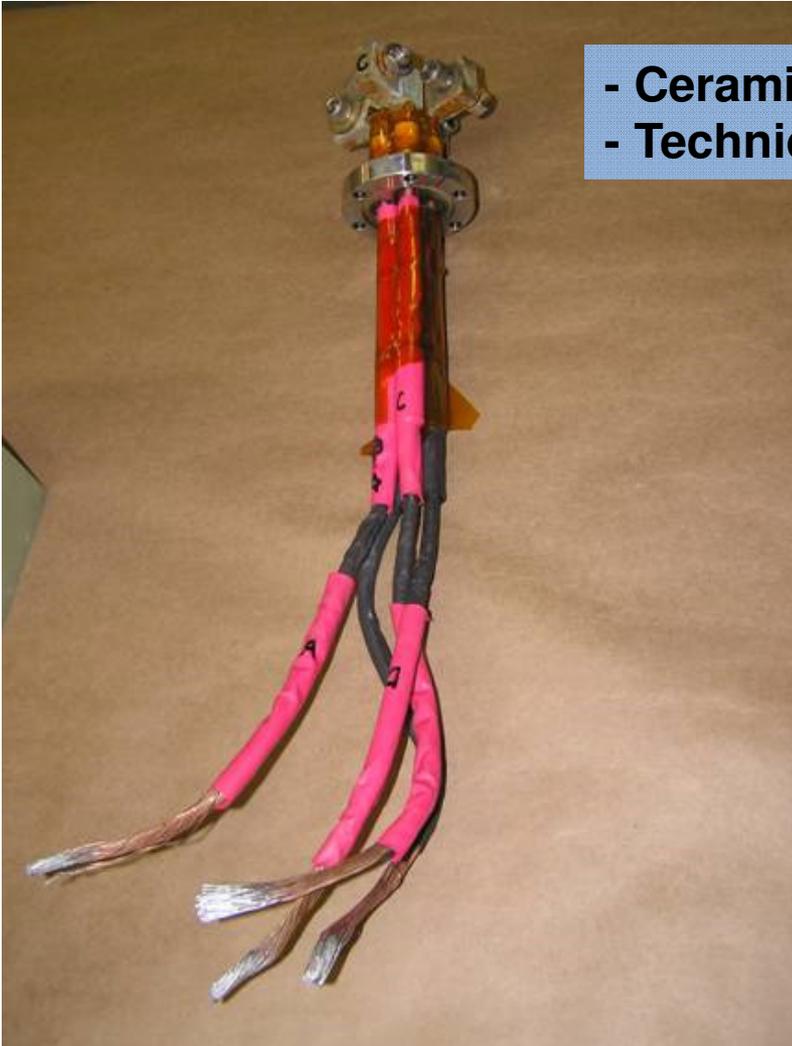


Single Stage Cooler for HTS Leads

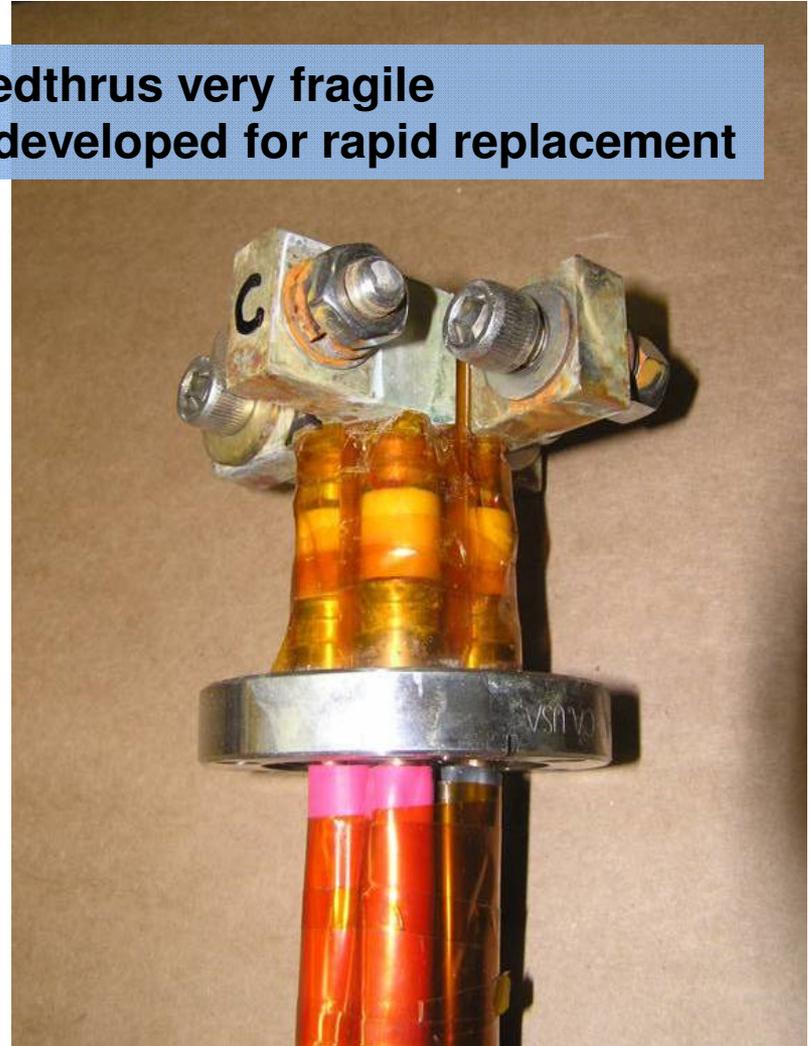


- Single stage cooler directly protects HTS leads
- 175 W of cooling power at 55K

Warm Lead/Feedthru Assembly



- Ceramic feedthrus very fragile
- Technique developed for rapid replacement



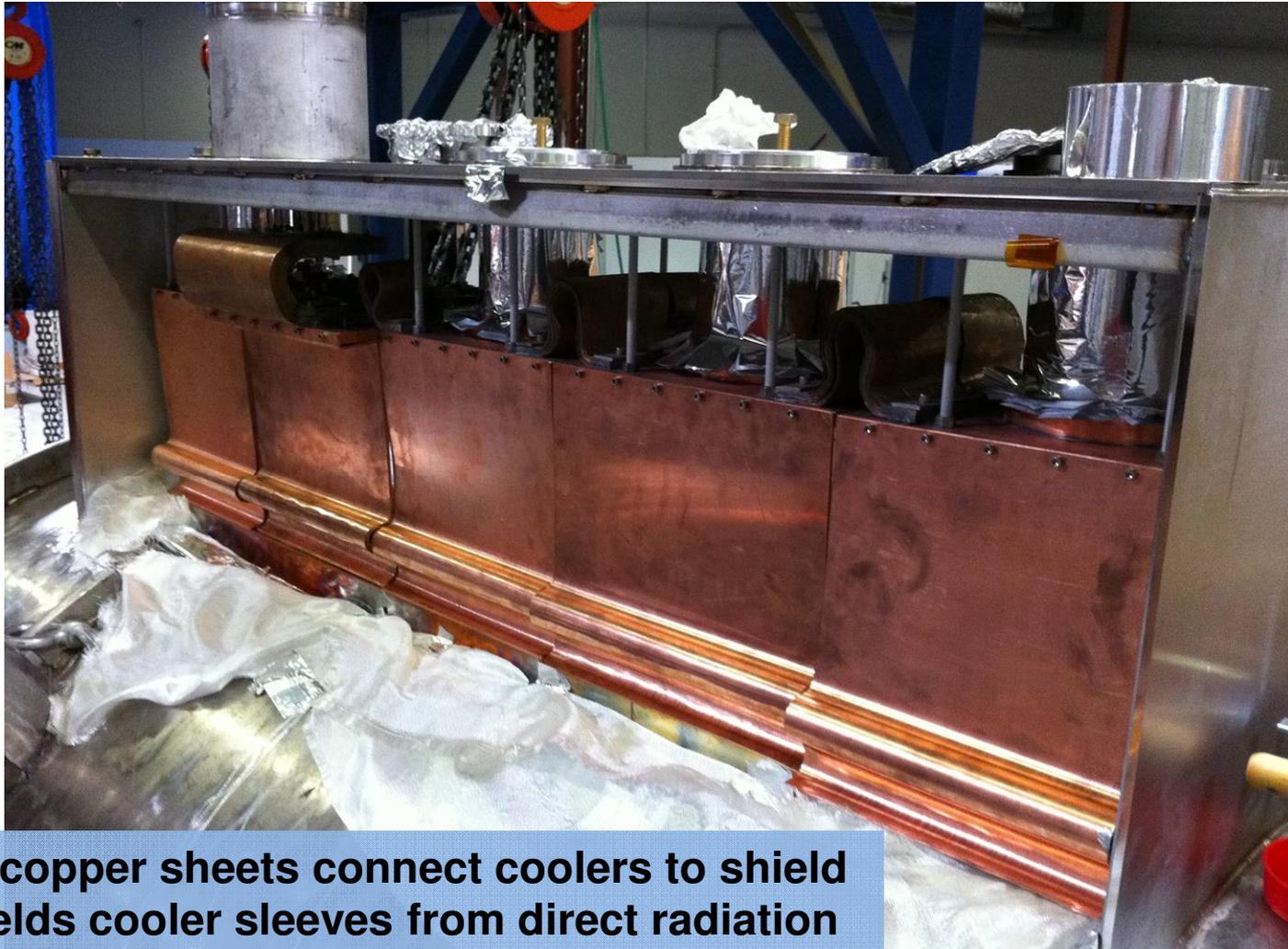


Power Feedthrus w/Copper Flags





1st Stage Cooler to Shield Connection



- Layered copper sheets connect coolers to shield
- Also shields cooler sleeves from direct radiation



Completed Cooler Tower Assembly





Completed Magnet





Other Information



- The two magnets shipped to RAL are virtually identical in design
- SSU (1st magnet completed) performed better cryogenically than SSD
- Wang NMR went thru several design iterations due to various performance deficiencies
- LBNL and MICE collaborators took a lead role in the final design and assembly of the magnets